ASSOCIATION FOR LIBRARY SERVICE TO CHILDREN

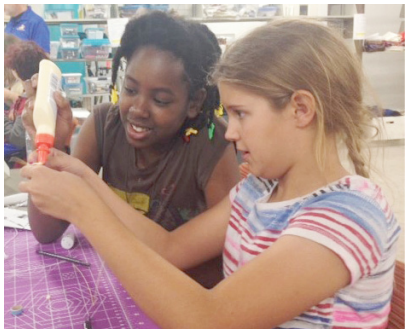
STEAM Learning in Public Libraries: A "Guide on the Side" Approach for Inclusive Learning

Brooks Mitchell, Claire Ratcliffe, and Keliann LaConte



Brooks Mitchell is Education Coordinator II at the National Center for Interactive Learning (NCIL) at the Space Science Institute (SSI) and works on professional development efforts across STAR Net projects. **Claire Ratcliffe**, an Education Coordinator I at SSI, received her MS in Natural Science Education from the University of Wyoming and has many years of experience teaching in formal and informal educational settings. **Keliann LaConte** is the Professional Development Manager at NCIL/SSI and Principle Investigator of STAR Net's new STEAM Equity project. The authors are part of the STAR Library Network, led by SSI's NCIL.

Children and their families are practicing STEAM (Science, Technology, Engineering, Arts, and Math) skills through a library program. Hand-crank generators and LED bulbs are set out on each of the tables, along with two types of dough—conductive play dough and insulating modeling clay.


STEAM learning at Tom Greene County Library in San Angelo, Texas.

Together, they work as engineers to create a model of a neighborhood, complete with houses and other structures from their imaginations. But first, they must each figure out how to light the LED bulb using only the materials provided.

The facilitator visits each table to see what strategies the families are using to light the bulb. After a few minutes, two girls still struggle to make the connection. The facilitator first prompts their thinking with a question: "What could you do to make sure the electricity goes through the lightbulb and not just the play dough?" The two girls don't say anything. They seem unsure. Rather than *tell* them how circuits work, the facilitator gives them the time they need to explore, promising, "I'll let you think about it and come back."

The girls decide to connect the LED across two separate lumps of playdough. They're on the right track! With other families, the facilitator encourages persistence: "That's part of engineering, you try again and again." After successfully collaborating on their circuits, some families look up books about electricity. One girl stays to help clean up with her family and remarks, "I want to be an engineer when I grow up."[1]

From decades of discovering how the brain works and how people learn, we now understand that the families don't simply need "the answer" given to them.[2] For learning to occur, people must experience a scenario, context, or investigation that calls for them to interact and process concepts, facts, and ideas in a meaningful way. The struggle and conversation leads families to succeed at an activity like Go GREEN with Creative Circuits.[3]

Whether you are new to STEAM or building on past experiences, the STAR Library Network (STAR Net) offers this and other free Science-Technology Activities and Resources (STAR) at https://starnetlibraries.org to take STEAM learning to new levels in your library.

As a library staff member, you bring skills that are highly effective in STEAM learning, ranging from expertise in engaging both youth and caregivers to coordinating the logistical details of programs. Irrespective of your background in STEAM, you have an ability to bring members of your community together for interactive learning and to share your excitement with STEAM topics.

Families do not need you to be a walking encyclopedia of STEAM facts. As a STEAM facilitator, it can be appropriate to say, "I don't know. Let's find out together!"

In a single program, you might encounter a range of ages, backgrounds, languages, or skills. How can a facilitator empower these diverse learners to discover answers for themselves?

Facilitation Styles

At some point, you've likely sat in a lecture. This is an example of "teaching as telling," led by a "sage on the stage." Here, the experience is focused on the facilitator, who is expected to have all the knowledge and deliver specific information to a group. It is unlikely that you had much interaction with other members of the audience or their viewpoints. This style can be beneficial in certain contexts, such as giving safety instructions. However, "sage on the stage" instruction is not the most effective for STEAM explorations.[4]

A facilitator might take on the role of "trivia master" and follow a pattern where the facilitator asks a question (such as "what do we call these?"), the learners raise their hands, someone is selected to answer, and the facilitator confirms their knowledge or provides the correct answer. While this facilitation style encourages more participation than the "sage on

the stage" style, such questioning is pitched at recalling facts and simple yes/no answers and tends to favor participation from extroverted learners.[5]

A "guide on the side" elicits learners' thoughts, ideas, and conceptions and encourages learners to work together to build new understanding or skills for themselves.[6] After all, science isn't just a collection of facts but a process of observation, inquiry, and exploration. Facilitators must take on the role of dialogue leader, rather than the keeper of knowledge.

Valerie Marshall, Broward County (FL) Library, notes that this strategy "puts my staff who may not be as comfortable facilitating STEM at ease, while also making customers more confident that they won't 'mess up' in front of an expert." Learners morph from being passive receptors of facts to active participants in playful discussions and explorations, and the facilitator gets the opportunity to learn alongside the participants, relinquishing the burden of being expected to know all the answers. A "guide on the side" facilitator chooses prompts, questions, and STEAM activities carefully to set families up for learning explorations. Here are simple tips to try in your own programs.

Try, Try Again

Use carefully worded questions and prompts to create a "culture of error," where participants aren't afraid to answer. Praise learners who are brave enough to ask questions ("I like your thinking") and encourage others to offer answers ("who can help him out?"). Emphasize that being "wrong" is simply sharing your current thinking and is an important first step toward discovering the "right" answer. Avoid providing the answer right away to dispel the perception that the facilitator holds all of the knowledge.[7]

During the NASA engineering design challenge, Touchdown, children discover and learn through playful failure.[8] In this activity, learners use a plastic cup and a variety of other common materials to create a shock-absorbing system to protect two marshmallows (the "astronauts") from a predetermined drop height. While it might be tempting to "give in" and provide a proven solution, instead encourage iteration with prompts like, "What about your design worked well during the first drop? What might you change for the second drop?"

As with most engineering design challenges, children will find multiple creative ways to solve this problem.

Whose Voices are Being Heard?

A key element of being a "guide on the side" facilitator is to find ways to encourage discussion among the learners while minimizing your own talking time.

Open-ended questions are based on a person's own observations and thoughts; for example, "What do you notice about this?" "What do you think will happen next?" or "How are they alike?" This opens up the conversation to everyone in the room, no matter their level of background knowledge or skills, and connects directly with their personal or family experiences. For example, in the activity "Searching for Life," questions early in the activity encourage participants to ponder the characteristics of life ("What tells you something is alive?"), then later use those same ideas in a simple experiment.[9] Illustrated activity instructions and questions are included with this activity to encourage participation from learners who speak other languages or respond more to visual prompts.

Provide a wait time of about five seconds after asking a question so that everyone can think about and articulate their ideas.[10] Try responding first to someone who took a little longer to form their thoughts—after all, we need deep thinkers to help us tackle the challenges of the future!

Atlas Logan of Gwinnett County (GA) Public Library said the "guide on the side" approach has been "a great strategy in our library, especially when working with young audiences. Children love to explore and figure things out; using 'guide on the side' keeps them much more engaged than if we were acting as a 'sage on the stage.' . . . The 'wait time' is helpful because it reminds facilitators to ask open-ended questions and it sets the expectation that we are looking for thoughtful responses and discussion."

We Learn from Each Other

Make sure all voices are being heard—and manage any individuals who might be dominating a whole group conversation—by setting up smaller groups for discussion. Pose your question, then invite the audience to "turn and talk with a family member or friend about your ideas." Allow them to chat for a few minutes, then regroup and invite everyone to share out to the larger group.[11] You can further facilitate dialogue among the participants by inviting others to build on to what was said using the prompt, "who can add to that?"

When implemented effectively, storytelling can engage the audience emotionally and mentally and creates a shared experience.[12] In the activity "Who Dirtied the Water," the facilitator reads a story about water pollution as participants take turns adding "pollutants" (represented by everyday items) to a container of water when prompted by the narrative.[13] Probing questions are asked throughout the activity ("Would you swim in that water?" "Who is responsible for cleaning it up?"). No matter what their personal experience with water and pollution, everyone can contribute their diverse perspectives during this shared story.

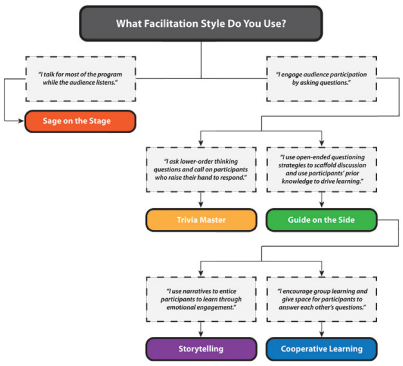


Figure 1. STEAM Facilitation Style Chart

Bringing It Back to Your Library

What facilitation style did you use during your last program? (Use the chart in figure 1 to reflect.) You might find that participants are expecting to have the "right" answer available to them from an instructor or an internet search, but seize the opportunity to facilitate deeper learning exploration. Like with many aspects of STEAM, this may be difficult at first but becomes easier with practice! Look for STEAM activities that lend themselves to learner-centered discovery or problem-solving and use thoughtful questions and prompts to make your STEAM programs even more inclusive. **&**

This material is based upon work supported by the National Science Foundation under Grant Number DRL-1657593 and NASA under cooperative agreement No. NNX16AE30A. Any opinions, findings, and conclusions or recommendations

expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation or the National Aeronautics and Space Administration.

References

1. This vignette is based upon actual dialogue and events at engineering programs at six public libraries.
2. National Research Council, *How People Learn: Brain, Mind, Experience, and School: Expanded Edition* (Washington, DC: The National Academies, 2000), https://doi.org/10.17226/9853.
3. National Center for Interactive Learning/Space Science Institute, “Go Green with Creative Circuits,” STAR Library Network, http://clearinghouse.starnetlibraries.org/engineering/201-go-green-with-creative-circuits.html.
4. Drew K. Ishii, *Constructivist Views of Learning in Science and Mathematics* (Columbus, OH: ERIC Clearinghouse for Science, Mathematics, and Environmental Education, ED 482 722, 2003).
5. Christine Chin, “Teacher Questioning in Science Classrooms: Approaches that Stimulate Productive Thinking,” *Journal of Research in Science Teaching* 44, no. 6 (2007): 815–43.
6. Kenneth E. Vogler, “Improve Your Verbal Questioning,” *The Clearing House: A Journal of Educational Strategies, Issues, and Ideas* 79, no. 2 (2005): 98–103.
7. Doug Lemov, *Teach Like a Champion: 62 Techniques that Put Students on the Path to College* (San Francisco: Jossey-Bass, 2015).
8. NASA Jet Propulsion Laboratory, “Touchdown,” http://clearinghouse.starnetlibraries.org/engineering/235-touchdown.html.
9. Lunar and Planetary Institute, “Searching for Life,” http://clearinghouse.starnetlibraries.org/biology/160-search-for-life.html.
10. Patricia E. Blosser, *How to Ask the Right Questions* (Arlington, VA: National Science Teachers Association Press, 1991).
11. Doug Lemov, *Teach Like a Champion*.
12. Dee H. Andrews, Jennifer A. Donahue, and Thomas D. Hull, “Storytelling as an Instructional Method: Definitions and Research Questions,” *Interdisciplinary Journal of Problem-Based Learning* 3, no. 2 (2009).
13. United States Environmental Protection Agency, “Who Dirtied the Water: A Role Playing Activity,” http://clearinghouse.starnetlibraries.org/earth-science/170-who-dirtied-the-water-a-role-playing-activity.html.

Refbacks

- There are currently no refbacks.